Electronic Version
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Claims

[c1] 1. A cooling system for a vehicle having first and second spaces to be cooled, the cooling system including first and second heat exchangers for respectively cooling air flowing into the first and second vehicle spaces, and a conduit system in communication with the first and second heat exchangers and configured to provide a fluid flow path to and from the heat exchangers, the cooling system further including a pump selectively operable for moving fluid through the conduit system, and first and second valves in communication with the conduit system, the cooling system comprising:

a first sensor configured to measure a first temperature, and to output a signal related to the first temperature, the first temperature being indicative of the temperature of air exiting the first heat exchanger;

a second sensor configured to measure a second temperature, and to output a signal related to the second temperature, the second temperature being indicative of the temperature of air exiting the second heat exchanger; and

a controller in communication with the first and second sensors, and with at least one of the pump and the first

and second valves, the controller being configured to effect a stoppage of fluid flow to the first heat exchanger when the first temperature is below a predetermined temperature, and to effect a stoppage of fluid flow to the second heat exchanger when the second temperature is below the predetermined temperature.

[c2] 2. The cooling system of claim 1, wherein the controller is configured to effect a stoppage of fluid flow to the first and second heat exchangers by stopping operation of the pump.

[c3] 3. The cooling system of claim 1, wherein the controller is in communication with the first and second valves, and wherein the controller is configured to effect a stoppage of fluid flow to the first heat exchanger by closing the first valve, and to effect a stoppage of fluid flow to the second heat exchanger by closing the second valve.

[c4] 4.The cooling system of claim 1, further comprising a reservoir communicating with the conduit system, and configured to temporarily store at least some fluid flowing in the conduit system, and to facilitate separation of liquid and vapor in the stored fluid.

[c5] 5.The cooling system of claim 1, wherein the pump includes one of a compressor having a clutch, a variable

displacement compressor, and a high-voltage, integrated electric motor driven compressor.

[c6] 6. The cooling system of claim 1, further comprising a third heat exchanger communicating with the conduit system and disposed between the pump outlet and the first and second heat exchangers, the third heat exchanger being configured to cool fluid flowing in the conduit system.

[c7] 7. The cooling system of claim 6, further comprising first and second throttling devices, each of the throttling devices communicating with the conduit system, and configured to effect a reduction in pressure of fluid flowing through the conduit system, the first throttling device being disposed between the first valve and the first heat exchanger, the second throttling device being disposed between the second valve and the second heat exchanger.

[c8] 8. The cooling system of claim 7, the pump including an inlet and an outlet, the cooling system further comprising a pressure sensitive device disposed between the pump outlet and one of the throttling devices, the pressure sensitive device being configured to determine a fluid pressure in the conduit system, and to effect shutdown of the pump when the determined fluid pressure is

above a predetermined pressure.

[c9] 9. The cooling system of claim 8, further comprising at least one fan disposed in relation to the third heat exchanger for moving air through the third heat exchanger, and wherein the pressure sensitive device is further configured to effect selective operation of the fan in response to the determined fluid pressure in the conduit system.

[c10] 10. The cooling system of claim 1, wherein the first vehicle space is a passenger compartment, and the second vehicle space is a battery compartment.

[c11] 11. The cooling system of claim 10, the vehicle having a battery disposed within the battery compartment, the cooling system further comprising a duct system having at least a portion of the second heat exchanger disposed therein, the duct system being configured to selectively provide fluid communication between the battery and an ambient environment outside the vehicle.

[c12] 12. The cooling system of claim 11, further comprising a fan cooperating with the duct system for moving air through at least a portion of the duct system and across the battery.

[c13] 13. A cooling system for a vehicle having first and sec-

ond spaces to be cooled, the cooling system including first and second heat exchangers for respectively cooling air flowing into the first and second vehicle spaces, and a conduit system in communication with the first and second heat exchangers and configured to provide a fluid flow path to and from the heat exchangers, the cooling system further including a pump and first and second valves, the pump having an inlet and an outlet and being selectively operable for moving fluid through the conduit system, each of the valves being in communication with the conduit system, the cooling system comprising:

a switch disposed between one of the heat exchangers and the pump inlet, the switch being configured to determine a fluid pressure in the conduit system, and to effect shutdown of the pump when the determined fluid pressure is below a predetermined pressure.

[c14] 14. The cooling system of claim 13, further comprising a reservoir communicating with the conduit system, and configured to temporarily store at least some fluid flowing in the conduit system, and to facilitate separation of liquid and vapor in the stored fluid.

[c15] 15. The cooling system of claim 13, further comprising a third heat exchanger communicating with the conduit system and disposed between the pump outlet and the

first and second heat exchangers, the third heat exchanger being configured to cool fluid flowing in the conduit system.

[c16] 16. The cooling system of claim 15, further comprising first and second throttling devices, each of the throttling devices communicating with the conduit system, and configured to effect a reduction in pressure of fluid flowing through the conduit system, the first throttling device being disposed between the first valve and the first heat exchanger, the second throttling device being disposed between the second valve and the second heat exchanger.

[c17] 17. The cooling system of claim 16, further comprising a pressure sensitive device disposed between the pump outlet and one of the throttling devices, the pressure sensitive device being configured to determine a fluid pressure in the conduit system, and to effect shutdown of the pump when the determined fluid pressure is above a predetermined pressure.

[c18] 18. The cooling system of claim 17, further comprising at least one fan disposed in relation to the third heat exchanger for moving air through the third heat exchanger, and wherein the pressure sensitive device is further configured to effect selective operation of the fan in re-

sponse to the determined fluid pressure in the conduit system.

[c19] 19. The cooling system of claim 13, wherein the first vehicle space is a passenger compartment, and the second vehicle space is a battery compartment.

[c20] 20. The cooling system of claim 19, further comprising a duct system having at least a portion of the second heat exchanger disposed therein, the duct system being configured to selectively provide fluid communication between the battery and an ambient environment outside the vehicle.

[c21] 21. A vehicle having a passenger compartment and a battery, the vehicle comprising:
a cooling system including,
a) first and second heat exchangers, the first heat exchanger being disposed in relation to the passenger compartment for selectively cooling air flowing into the passenger compartment, the second heat exchanger being disposed in relation to the battery for selectively cooling air flowing across the battery,
b) a conduit system in communication with the first and second heat exchangers, and configured to provide a fluid flow path to and from the heat exchangers,
c) a pump selectively operable for moving fluid through

the conduit system,

d) first and second valves, each of the valves communicating with the conduit system, the first valve being configured to selectively inhibit fluid flow to the first heat exchanger, the second valve being configured to selectively inhibit fluid flow to the second heat exchanger,

e) first and second sensors, the first sensor being configured to measure a first temperature indicative of the temperature of air exiting the first heat exchanger, and further configured to output a signal related to the first temperature, the second sensor being configured to measure a second temperature indicative of the temperature of air exiting the second heat exchanger, and further configured to output a signal related to the second temperature, and

f) a controller in communication with the first and second sensors and at least one of the pump and the first and second valves, the controller being configured to effect a stoppage of fluid flow to the first heat exchanger when the first temperature is below a predetermined temperature, and to effect a stoppage of fluid flow to the second heat exchanger when the second temperature is below the predetermined temperature.

[c22] 22. The vehicle of claim 21, wherein the controller is configured to effect a stoppage of fluid flow to the first

and second heat exchangers by stopping operation of the pump.

[c23] 23. The vehicle of claim 21, wherein the controller is configured to effect a stoppage of fluid flow to the first heat exchanger by closing the first valve, and to effect a stoppage of fluid flow to the second heat exchanger by closing the second valve.

[c24] 24. The vehicle of claim 21, wherein the cooling system further comprises a duct system having at least a portion of the second heat exchanger disposed therein, the duct system being configured to selectively provide fluid communication between the battery and an ambient environment outside the vehicle.